(No Model.) 3 Sheets—Sheet 1.

W. A. JACKSON & W. R. COLE.

TELEPHONE SYSTEM.

No. 301,603. Patented July 8, 1884.

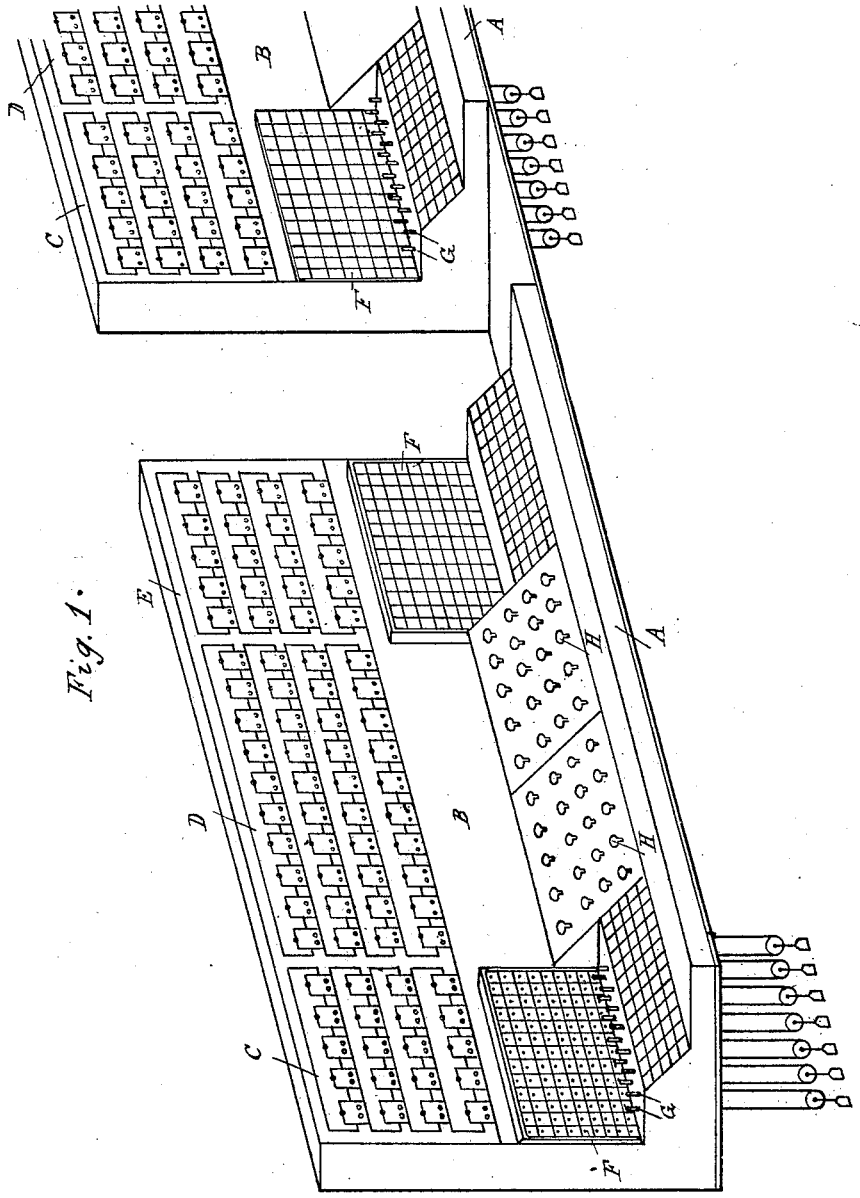


Fig. 1.

Attest
J. Paul Mayer

Inventors
William A. Jackson
and William R. Cole
By Thos. S. Sprague Atty

(No Model.) 3 Sheets—Sheet 2.

W. A. JACKSON & W. R. COLE.

TELEPHONE SYSTEM.

No. 301,603. Patented July 8, 1884.

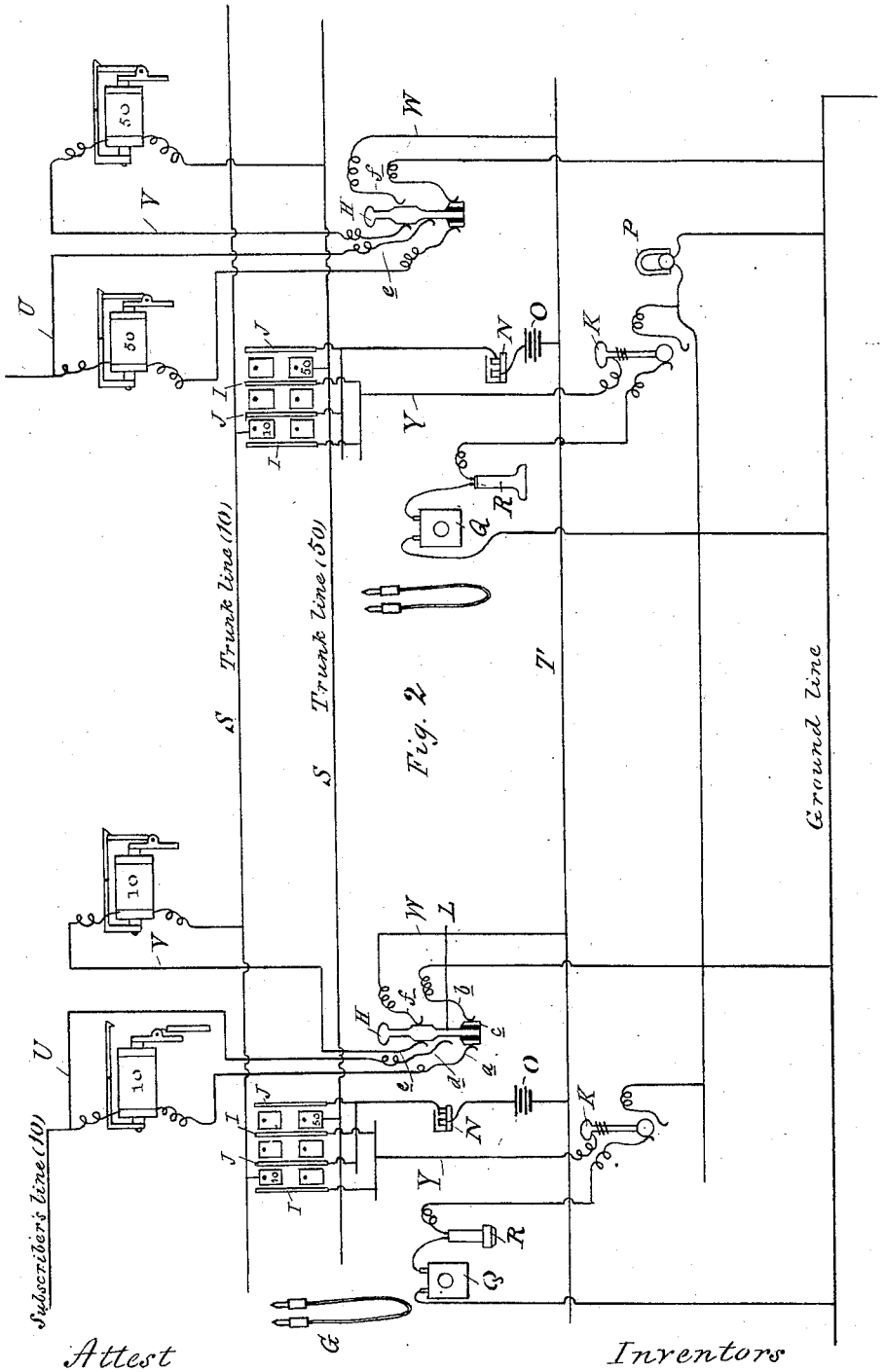


Fig. 2

Attest
J. Paul Mayer

Inventors
William A. Jackson
and William R. Cole
By Thos. J. Symmes Atty

(No Model.) 3 Sheets—Sheet 3.

W. A. JACKSON & W. R. COLE.

TELEPHONE SYSTEM.

No. 301,603. Patented July 8, 1884.

Fig. 3

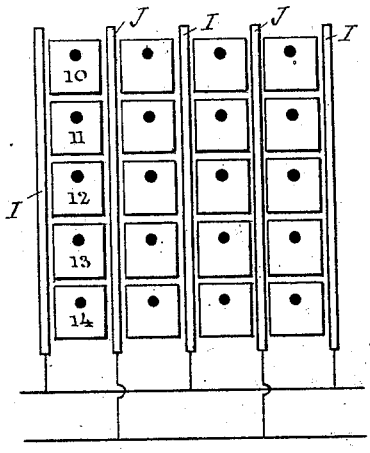
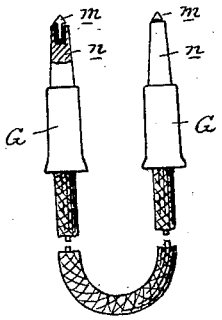


Fig. 6



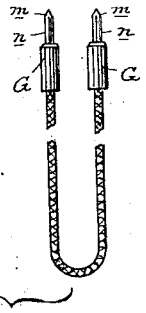


Fig. 4

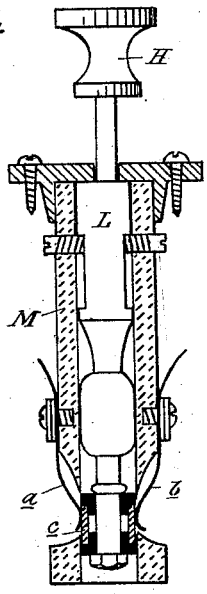
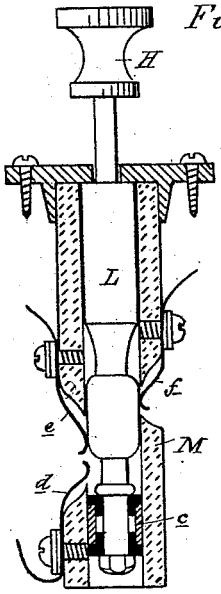


Fig. 5



Attest
J. Paul Mayer

Inventors
William A. Jackson
and William R. Cole
By Thos. S. Sprague Atty.

UNITED STATES PATENT OFFICE.

WILLIAM A. JACKSON AND WILLIAM R. COLE, OF DETROIT, MICH., ASSIGNORS TO THE WESTERN ELECTRIC COMPANY, OF CHICAGO, ILL.

TELEPHONE SYSTEM.

SPECIFICATION forming part of Letters Patent No. 301,603, dated July 8, 1884.

Application filed March 5, 1884. (No model.)

To all whom it may concern:

Be it known that we, WILLIAM A. JACKSON and WILLIAM R. COLE, of Detroit, in the county of Wayne and State of Michigan, have invented new and useful Improvements in Telephone Systems; and we hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, which form a part of this specification.

This invention relates to a new and useful improvement in telephone central-office apparatus of that class wherein multiple switch-boards are used; and the invention consists, first, in the grouping of the different apparatus; second, in the construction and arrangement of the switch-board; third, in the arrangement of local drops for announcing all orders for connecting and disconnecting; fourth, in the peculiar arrangement and connection of sliding switch-keys, which in their normal position ground the main lines and form connecting-links of a test-line circuit, and in their depressed position make all the line-plates of the same mark with the key terminals of the line; and, fifth, in the combination of the different apparatus into a complete system, all as herein described.

Figure 1 is a diagram perspective showing the grouping of the apparatus on a desk intended for two or three operators, similar desks being provided for other operators. Fig. 2 shows diagrams of so much of the apparatus as is necessary to work two subscribers' lines, together with all the different local connections. Figs. 3, 4, 5, and 6 are details which are specially referred to in the following description.

In the accompanying drawings, which form a part of this specification, A is the table or desk, provided with the back board, B, upon which are placed three groups of drops, C D E. The drops of groups C and E are main line or subscribers' drops, a certain number of which are formed into a group, and two of these are placed on each desk, as shown.

Between the groups of drops C E is placed the group of local drops D, which represent all the subscribers of groups C and E, and receive the local calls for connection to which the subscribers of groups C and E are respondents. Below each group of subscribers' drops is placed a switch-board, F, which has line-plates arranged in vertical and horizontal series for all the subscribers of the office. In front of each of the switch-boards are placed the connecting-plugs G, for connecting two subscribers on the switch-board. These plugs are connected in pairs by flexible cords, which are automatically withdrawn below the table-top when the subscribers' lines are disconnected.

Between the switch-boards F F of each table, and below the group of local drops D, is placed a group of push-buttons, H, which form the projecting ends of sliding keys concealed in the table. There are as many push-buttons as there are subscribers' drops on the table. They are grouped and marked the same as the drop of groups C and E, and the left half of the group of push-buttons is within convenient reach of the operator on the left-hand switch-board, while the right half of the group is within convenient reach of the right-hand switch-board operator. The operators of each switch-board are also provided with the usual outfit, consisting of telephone, transmitter, and generator-switch for communicating and signaling. The grouping of the apparatus upon the desks admits of each operator attending to all the apparatus upon that half of the desk upon which his switch-board is located; but at the same time, if found more convenient or necessary, under stress of business, an extra operator may be placed in the center of each desk, whose business it is then to attend to all the local orders for connection and disconnection received on the local drops of group D and execute them by operating the push-buttons H in the proper manner.

In Fig. 2 is shown a diagram of so much of the apparatus and the various connecting-wires as is necessary to explain the operation of the same for connecting two subscribers. The letters used in this and the following figures refer to the individual apparatus instead of the whole group, as in Fig. 1, and the two subscribers are specially designated by the

Nos. 10 and 50, which numbers are also used to distinguish the apparatus of their respective lines.

The construction of the different apparatus is as follows: The drops are in construction and operation of the usual character. The switch-board (shown in detail in Fig. 3) consists of a series of line-plates, one for each subscriber in the office. Each of these plates has a plug-socket for interconnection by means of two switch-plugs electrically connected together. In the interstices between the vertical rows of these line-plates are placed the talking and calling bars I, and test-bars J, alternately arranged so that each row of line-plates has on one side a talking and calling bar and on the opposite side a test-bar. These bars, in order to distinguish their nature, are made of different visual appearance; or each row of line-plates may have a separate set of these two kind of bars, which allows of their being placed in the same order for each row; but as space is a desiratum in the construction of switch-boards, the arrangement as shown will be found more preferable. The line-plates, together with the talking and calling bars I and test-bars J, are secured to a rubber base, so that a small electrical gap is formed between the plates and bars, which gap is bridged by the insertion of the point of the test-plug, worn as a thimble-plug on a finger of the operator, or by using one of the plugs G, which for the purpose are provided with special points, as shown in Fig. 3.

K is a foot-pressure button, provided with a sliding contact and a retracting-spring. It is placed convenient to one foot of the operator, and normally it makes electrical contact with a contact-spring which connects it with the operator's telephone; but upon being depressed it breaks such contact and forms a new contact, which connects it with the generator.

H is a pressure-button, to which is secured the sliding key L shown in detail in Figs. 4 and 5, which represent two vertical sections taken at right angles to each other. It is also shown in diagram in Fig. 2. This key is secured and slides within the rubber tube M, which has five contact-springs secured to it. Normally the lower two contact-springs, *a b*, impinge upon opposite sides of the key, near its lower end, which is there provided with a metal ferrule, *c*, insulated from the key, and which brings the contact-springs *a b* into electrical contact, which is, however, broken when the key is depressed. The contact-spring *d* is normally out of contact with the key, which, however, on being depressed, forms an electrical contact therewith. The contact-spring *e* keeps always in electrical contact with the key, and the contact-spring *f* is normally in contact with the key, which contact is broken by depressing the key. Thus normally the sliding key makes two independent electrical contacts, between the contact-springs *a b* and *e f*, and upon being depressed breaks these contacts, but forms a new one between the contact-springs *d e*. The sliding key L is unprovided with a retracting-spring, so that it keeps in its depressed position until it is pulled back by hand to its normal position.

N is a sounder of suitable construction, to give an audible signal when a battery-current is flowing through it.

O is a local battery.

G are two plugs electrically connected together by a covered wire.

P is the generator.

R is the operator's telephone, and Q his transmitter.

The wire connections inside the office between the different apparatus are as follows: The main line, (of which there is one for each subscriber,) after passing through the subscriber's drop, connects with the contact-spring *a*, and its ground terminal is connected to the contact-spring *b*. As the lower end of the sliding key L normally bridges the electrical gap between the two contact-springs *a b*, the main line is thus normally grounded.

S S are normally open trunk-lines—one for each subscriber in the office. Each of these trunk-lines electrically connects all those line-plates on the switch-boards which are marked the same.

T is the test-line, which connects electrically all the test-bars J on all the switch-boards. This line is normally open, and has the test-batteries O and sounders N—one for each switch-board included in its circuit.

U is a branch wire connecting each main line before it enters its drop with the contact-spring *d* of the correspondingly-marked key.

V is a branch wire—one for every local drop. It connects at one end with the correspondingly-marked trunk-line, and, after passing through the local drop, connects onto the spring-contact *e* of its correspondingly-marked key.

W is a branch wire connecting the contact-spring *f* of each key with the test-line.

Y is a branch wire connecting the foot-pressure button of each operator with all the talking and calling bars on his switch-board.

The operation of connecting two subscribers by means of the apparatus and connections just described is as follows: Suppose the drop 10 has announced a call from subscriber 10, the operator on this board immediately depresses the sliding key 10. This breaks the ground of No. 10, as the contact-springs *a b* break their contact with the metal ferrule *c*, which heretofore connected them electrically. The operator then bridges with a plug the electrical gap between line-plate 10 and its adjoining talking and calling bar I. This brings his telephone into the subscriber's 10 circuit, which is now established over the branch wire U, contact-spring *d*, key 10, contact-spring *e*, branch wire V, local drop 10, trunk-line 10, line-plate 10, talking-bar I, branch wire Y, foot-pressure button K, and thence through

telephone and transmitter into ground. Upon ascertaining the subscriber's wants, which we will suppose is a call for connection with subscriber No, 50, the operator bridges with a plug the electrical gap between the line-plate 50 of his board and its adjoining test-bar. This establishes a test-circuit which includes the local drop of No. 50 and actuates it, the circuit being established as follows: from line, plate 50 to its adjoining test-bar J, thence through sounder N, battery O, test-line T, contact-spring *f*, and sliding key 50 to contact-spring *e*, over branch-wire V to local drop 50, then over trunk-line 50 back to line-plate 50, thus completing the circuit. The operator who has applied the test is informed by the signal from his sounder that the line of subscriber 50 is free, as otherwise he could not establish the test-circuit through the sliding key 50, which would necessarily be depressed if line 50 were in use. The operator in charge of No. 50 local drop, upon seeing this drop open, immediately construes this order as a local call for connection, and depresses the sliding key No. 50. This gives the first operator also control of No. 50 line, as the line-plate 50 on his board is now a terminal for this subscriber's line, the same as line-plate 10 is a terminal for subscriber 10 line, the connection in each case being established from subscriber's line over branch wire U, contact-spring *d*, sliding key, contact-spring *e*, branch wire V, local drop, to trunk-line, and thence to line-plate. The operator now proceeds to ring and call up the respective subscribers, and then connects them by means of two connected plugs inserted in the plug-sockets of the respective plates. The bars I are normally talking-bars—that is, they are connected with the operator's telephone and transmitter; but upon depressing the foot-pressure button K the talking connection is broken and the generator is connected, so that the operator, by bridging the electrical gap on a talking and calling bar, I, can talk or signal as the circumstances require. As the talking-circuit of the two subscribers passes through their local drops in ringing off, the local drops will open, whereupon the respective operators restore the sliding keys 10 and 50 to their normal position.

The *modus operandi* of connecting any two subscribers is the same whether they are in the same or in different groups. In the former case, however, the use of the test-circuit may be obviously omitted.

In Fig. 6 a modification of a pair of connected plugs is shown, which we prefer to those shown in Fig. 3. The difference in their construction is that in Fig. 6 the tips *m* and body *n* of the plugs are electrically disconnected, while in Fig. 3 they are electrically connected, and the advantage we gain is this: The operator, after using one of the two connected plugs for making the talking-connection with a subscriber in answer to a call, can put the same in the plug-socket of the line-plate of this subscriber, and then use the other plug of the pair for testing and calling and connecting. Thus the operator cannot forget the number of the line-plate of the first party, whereas with plugs having non-insulated tips the operator must either first finish the whole operation of talking, testing, and calling before he can put a plug in line-plate, or he must use a separate plug (thimble-plug) for calling.

What we claim as our invention is—

1. The combination, in a telephone central-office switch, of a series of line plates or blocks arranged in vertical rows and constituting the line-connections on the switch-board, of two series of vertical strips or bars arranged with an electrical gap between said rows, one series constituting talking and calling bars and the other series constituting test-bars, the two series of bars being so arranged that two different bars are on opposite sides of each row of line-plates.

2. In a telephone central-office apparatus of the kind described, the combination of the following elements: a multiple switch-board, a group of subscribers' drops, and an operator's outfit at each end of the desk or table, a group of local drops, marked the same as the adjoining groups of subscribers' drops, placed between the same, and a group of switch-keys, marked the same as the drops, placed between the switch-boards, so that each of two operators may handle the apparatus of one-half of the desk, or an extra operator be employed for working the locals, as described.

3. The combination, in a telephone central-office switch, of a series of vertically-arranged line plates or blocks constituting the line-connections on the switch-board, of a series of vertical strips or bars, one for each row of line-plates, and arranged with an electrical gap between said line-plates, and of the foot-pressure button K and its connections, which normally connects the series of strips with the operator's talking outfit, and when depressed connects with the generator, substantially as and for the purposes described.

4. The combination, in a telephone central-office apparatus, of a series of multiple switch-boards, each provided with a series of line-plates normally disconnected from the lines, of a series of trunk-lines, one for each subscriber, and connecting all the line-plates of like mark, of a series of branch lines, U V, connecting each of the main lines at a point outside its drop with its corresponding trunk-line, and having a local drop in its circuit, and of a series of switch-keys, one for each line, and forming a make-and-break contact in each main line and in its branch lines, whereby the main lines are either grounded or may be connected to their respective trunk-lines, substantially as and for the purpose described.

5. The combination, with the telephone-lines centering in an office, of a series of switches normally connecting the lines with branches to earth, of a series of line-plates upon multiple boards normally disconnected from the lines and constituting the line-con-

nections, of a series of trunk-lines connecting all the line-plates of like mark, of a series of branch lines, U V, connecting the lines with the trunk-lines through local drops, and of a series of switches in these branch lines interlocking with the first series of switches.

6. The combination, substantially as described, of a series of lines normally disconnected from the line-plates of multiple switch-boards, of a series of trunk-lines, each connected to all the line-plates of like mark, of a series of branch lines, U V, connecting each line with its trunk-line, and of a series of switch-keys, one for each line, and forming a normally-closed switch between each line and its earth terminal and a normally-open switch between each line and its trunk-line.

7. The combination, substantially as described, of a series of multiple switch-boards having line-plates arranged in vertical rows, of a series of testing-bars, one for each vertical row of line-plates, and arranged with an electrical gap between the same, of a test-line having a battery or batteries in its circuit, and connecting-wires with all the testing-bars, of a series of sounders, one in each connecting-wire between the test-line and the test-bars of each board, of a series of trunk-lines connecting all the like line-plates, and of a series of branch wires, W V, connecting each trunk-line with the test-line, and including a local drop and a normally-closed switch.

8. In a telephone-exchange system wherein the lines are grouped, the combination of a series of vertical test-strips arranged with an electrical gap between the vertical rows of line-plates which constitute the line-connections, of trunk-lines connecting all the line-plates of like mark, of a series of multiple boards, of a test-line having a battery on its circuit and branch connections, including a sounder to each series of test-bars on a board, of a series of branch connections, W V, one between the test-line and each trunk-line, and having the local drop on its circuit, of a series of sliding keys, each forming a normally-closed switch on the test-circuit, and a normally-closed switch between the line and its earth terminal.

9. The combination, with a series of telephone-lines centering in an office, of a series of earth-connections for the lines, of multiple switch-boards having line-plates provided with talking and calling bars and test-bars and means for operating the same, of a series of trunk-lines connecting the like line-plates, of a series of branch wires, U V, connecting the lines with their trunk-lines, and having each a local drop on their circuits, of a test-line connecting onto all the test-bars, and having a series of branch connections, W V, one to each trunk-line, and of a series of switch-keys, one for each line, and forming three interlocking make-and-break connections, one between each main line and its earth terminal, one in each branch connection U V, between each line and trunk-line, and one in each branch connection W L, between test-line and trunk-line, the former two being normally closed and the latter one normally open.

10. In a telephone central-office switch, the combination, substantially as described, of a series of sections, each consisting of a group of lines, and of a multiple switch-board provided with line-connecting plates normally disconnected from the lines, and having talking, calling, and test circuits, with means for operating the same, substantially as described, with a series of trunk-lines connecting all the line-plates of like mark, and a test-line connecting all the test-bars.

11. The combination, with a series of subscribers' lines connected in groups and having normally-closed branch terminals to earth, of multiple boards, one for each group of lines, having line-plates normally disconnected from the lines, and trunk-lines connecting the plates of like mark, of a series of switch-keys formed in groups corresponding with the line-groups, such key operating two switches, one between each line and its earth terminal and one in a branch line which connects each line with its trunk-line.

12. In a telephone-exchange switch, substantially as described, the combination of a series of local drops, one for each line, and of a corresponding series of switch-keys, with a series of single branches, U, V, and W, constructed and arranged substantially as described, whereby at the normal position of each key the branches V W are united to form a connection between a trunk-line and the test-line, and at the alternative position of each key the branches U V are united to form a connection between a line and its trunk-line, the connection including in each instance the local drop.

13. The combination, with a series of multiple telephone switch-boards, grouped in pairs and having normally-disconnected line-plates, of a series of switch-keys formed in groups, one group between each pair of switch-boards, and controlling normally-closed switches to earth in a corresponding group of lines, and normally-open switches in branch lines which connect the lines with the line-plates of like mark.

14. The combination, in a telephone-exchange switch, of a series of line-plates constituting line-terminals normally disconnected from the lines and arranged in vertical rows, of series of test-bars in electrical proximity with each row of line-plates, and of a normally-open test-circuit, including a local battery and audible and visual signal apparatus, said test-circuit forming terminals of all the normal line-plates and of all the testing-bars on all switch-boards, so that on bridging the electrical gap between any normal line-plate and a testing-bar a closed circuit is obtained which gives an audible signal to the testing operator and a visual signal to the operator in charge of the line of the tested line-plate.

15. The combination, with a series of subscribers' lines arranged in groups, of multiple

switch-boards the line-blocks of which form terminals of normally-open trunk-lines, of switch-keys for disconnecting the lines from earth and connecting them with their corresponding trunk-lines, of talking and calling bars arranged in proximity to the line-plates and connected with the usual operator's outfit for talking and signaling, and of a normally-open test-circuit which includes a local battery, an audible signal for each board, and a visual signal for each line, and forms terminals of all normal line-blocks and terminals of test-bars arranged in proximity to the line-blocks, substantially as described.

16. In a telephone-exchange switch, the combination of a series of line plates or blocks provided with plug-sockets, and constituting in operation the connecting-terminals of the lines, of a series of talking and calling bars arranged with an electrical gap on one side of each row of line-plates, of a series of test-bars arranged with an electrical gap on one side of each row of line-plates, and of a series of plugs connected in pairs for interconnecting the line-plates and bridging the electrical gaps, and provided with devices for withdrawing them when out of use, so that the connecting-cords are concealed below the table and the plugs arranged above and in front of the line-plates of the switch-board.

17. The combination of the sliding metal key L and the insulated metallic ferrule *c* upon its lower end with a stationary tube, M, inclosing said key L, and carrying the contact-springs *a b d e f*, the parts being constructed and arranged substantially as set forth, whereby on actuating the key L either the distinct electrical connections *a b* and *e f* are established or broken and a new electrical connection, *d e*, formed, substantially as and for the purposes described.

18. The combination of a series of line-plates having plug-sockets and constituting the line-connecting terminals of a series of talking, calling, and test bars arranged in proximity to the line-plates, a series of plugs electrically connected in pairs and provided with insulated metallic tips, substantially as set forth.

WILLIAM A. JACKSON.
WILLIAM R. COLE.

Witnesses:
H. S. SPRAGUE,
E. SCULLY.